## **CLAIMS**

1	1. A charge pumping system capable of a forward operation mode and a
2	reverse operation mode, wherein in forward operation mode the charge pumping
3	system can step-up an input voltage at a ratio of ½:1 and can step-down the input
4	voltage at a ratio of at least one of 1:1, 3:2, 2:1 and 3:1, and wherein in reverse
5	operation mode the charge pumping system can step-down the input voltage at a ratio
6	of 1:1/2 and 1:1 and can step-up the input voltage at a ratio of at least one of 2:3, 1:2
7	and 1:3.
1	2. The system of claim 1 comprising:
2	a first node operable to be connected as either an input node or an output node
3	for the system; and
4	a second node operable to be connected as either an input node or an output
5	node for the system.
1	3. The system of claim 1 comprising a switching component operable to be
2	configured to set the ratio for step-up or step-down for the forward and reverse
3	operation modes.
1	4. The system of claim 3 wherein the switching component comprises a
2	fractional switch having a plurality of segments.
1	5. The system of claim 4 further comprising a control circuitry for turning or
1	one or more segments of the fractional switch.
2	one of more segments of the fractional switch.
1	6. The system of claim 5 wherein the control circuitry implements a PFM
2	technique to turn on the segments.
1	7. The system of claim 1 wherein the system is implemented in a single
2	monolithic semiconductor die.



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1	8. A charge pumping system capable of a forward operation mode and a
2	reverse operation mode, the system comprising:
3	a first node operable to be connected as an input node in the forward operation
4	mode and as an output node in the reverse operation mode;
5	a second node operable to be connected as an input node in the reverse
6	operation mode and as an input node in the forward operation mode;
7	wherein in forward operation mode the charge pumping system can step-up an
8	input voltage at a ratio of 1/2:1 and can step-down the input voltage at a ratio of at
9	least one of 1:1, 3:2, 2:1 and 3:1, and wherein in reverse operation mode the
10	charge pumping system can step-down the input voltage at a ratio of 1:1/2 and 1:1
11	and can step-up the input voltage at a ratio of at least one of 2:3, 1:2 and 1:3; and
12	a switching component connected to the first node and the second node, the
13	switching component operable to be configured to set the ratio for step-up or step-
14	down for the forward and reverse operation modes, the switching component
15	comprising at least one fractional switch having a plurality of segments.

- 9. The system of claim 8 further comprising a control circuitry for turning on one or more segments of the fractional switch.
- 1 10. The system of claim 9 wherein the control circuitry implements a 2 PFM technique to turn on the segments.
- 1 11. The system of claim 8 wherein the system is implemented in a 2 single monolithic semiconductor die.